

CLAIMS

WHAT IS CLAIMED IS:

1. A system for detecting eye closure through optical observation of the eye, the system comprising:

5 a frame configured to be worn on a user;

a light source;

at least one eyepiece connected to the frame, the eyepiece having a reflective surface configured for reflecting light emitted from the light source onto the eye; and

10 a sensor connected to the frame and operable when positioned on the user to detect light reflected by the eye in a direction that is substantially parallel to the light incident on a retina of the eye to detect that the eye is in an open position.

2. The system of claim 1 wherein the optical device further comprises a beamsplitter configured for transmitting light onto the reflective surface.

15 3. The system of claim 1 wherein the sensor is a photodiode.

4. The system of claim 1 wherein the light source is an infrared light emitting diode.

20 5. The system of claim 1 wherein the reflective surface is formed by a coating on the eyepiece.

6. The system of claim 5 wherein the coating forms a hot mirror surface.

7. The system of claim 1 wherein the optical device and reflective surface are arranged such that an eye of the user acts as a retro-reflector upon receiving light reflected from the reflective surface.

8. The system of claim 1 wherein the frame is an eyeglass frame.

9. The system of claim 8 wherein the sensor and the light source are mounted on a side member of the frame.

10. The system of claim 1 wherein the frame is a helmet configured to be worn by the user and the eyepiece comprises a visor of the helmet.

11. The system of claim 1 wherein the sensor is positioned on the frame such that it is substantially unobtrusive to the user's field of view when the frame is mounted on the user.

12. The system of claim 1 further comprising a processor operable to convert an output signal received from the sensor into a signal identifying whether the eye is in an open or closed position.

13. The system of claim 1 further comprising an alarm configured for activation upon a predetermined eyelid movement condition.

14. The system of claim 13 wherein the eyelid movement condition is duration of eyelid closure.

15. The system of claim 1 wherein the reflective surface is concave.

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16. A system for monitoring eye movement through optical observation of the eye, the system comprising:

a frame configured to be worn on a user;

a light source;

10 at least one eyepiece connected to the frame, the eyepiece having a hot mirror surface configured for reflecting light emitted from the light source onto the eye; and

a sensor operable to detect light reflected by the hot mirror surface to detect whether the eye is in an open or closed position.

15 17. The system of claim 16 wherein the optical device further comprises a beamsplitter configured for transmitting light onto the hot mirror surface.

20 18. The system of claim 16 wherein the optical device and reflective surface are arranged such that an eye of the user operates as a retro-reflector upon receiving light reflected from the reflective surface.

19. The system of claim 16 wherein the light source is an infrared light emitting diode.

20. The system of claim 16 wherein the frame is an eyeglass frame.

21. The system of claim 20 wherein the sensor and the light source are mounted on a side member of the frame.

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22. The system of claim 16 wherein the frame is a helmet and the eyepiece is a visor.

10 23. The system of claim 16 further comprising a processor operable to convert an output signal received from the sensor into a signal identifying whether the eye is in an open or closed position.

24. A system for tracking eye movement through optical observation of the eye, the system comprising:

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a frame configured to be worn on a user;

a light source;

at least one eyepiece connected to the frame, the eyepiece having a reflective surface forming a hot mirror, the reflective surface of the eyepiece configured for reflecting light emitted from the light source onto the eye; and

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a camera mounted on the frame for monitoring movement of the eye when the frame is mounted on the user to sense a direction of gaze of the user's eye.

25. The system of claim 24 wherein the camera comprises a CCD.

26. The system of claim 24 wherein the light source is operable to generate infrared light.

27. The system of claim 24 wherein the optical device and the reflective surface are arranged such that an eye of the user acts as a retro-reflector upon receiving light reflected from the reflective surface.

28. A method for detecting eye closure through optical observation of the eye, the method comprising:

positioning an optical system on a user, the system comprising a reflective surface, a light source, and a sensor;

emitting light onto the reflective surface;

reflecting light from the reflective surface towards an eye of the user;

receiving light reflected from the eye operating as a retro-reflector at the sensor;

and

detecting at the sensor whether the eye is in an open or close position.

29. The method of claim 28 further comprising sending data generated by the sensor to an alarm.

30. The method of claim 29 further comprising initiating the alarm if the sensor detects eye closure for a predetermined period of time.

31. The method of claim 29 further comprising initiating the alarm if the sensor detects a predetermined number of eye closures within a specified period of time.

32. The method of claim 28 wherein the reflective surface is a hot mirror.

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33. The method of claim 28 further comprising tracking gaze of one of the user's eye.

34. The method of claim 28 further comprising sending data generated by the sensor to an electronic controller.

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35. The method of claim 34 further comprising processing said data received at the sensor before sending said data to the electronic controller.

36. The method of claim 34 wherein the electronic controller is a computer input device.

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37. The method of claim 28 further comprising sending data from the sensor to a communication device.

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